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# ESTIMATION OF NUTRITIONAL VALUE AND TRACE ELEMENTS CONTENT OF *CARTHAMUS OXYACANTHA, ERUCA SATIVA* AND *PLANTAGO OVATA*

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**Abstract**

*Carthamus oxyacantha, Eruca sativa* and *Plantago ovata* of the families *Asteraceae, Cruciferrae* and *Plantaginaceae* respectively are used by the local *Tabibs* (physicians) as medicinal plants to cure different diseases. In our present studies these plants were found to possess some medicinal properties including antihyperlipidemic, antihyperglycemic, antinephrolithiatic and hepatoprotective. In the present study estimation of nutritional value and trace element content of these plants were investigated. Different known standard techniques (Kjeldhal method, Lowery s' method and atomic absorption spectrophotometer) were used to estimate the nutritional value and trace element content.

Results showed that crude proteins, total proteins in seeds and total carbohydrates in leaves are significantly higher in *E. sativa* as compared to C. *oxyacantha* and *P. ovata.* The amount of total fats is significantly higher in seeds of *C. oxyacantha* as compared to *E. sativa and P. ovata.* While the concentration of crude fiber is significantly higher in seeds of *P. ovata* as compared to the seeds and leaves of both *E. sativa and C. oxyacantha*. Major trace elements include Cu, Fe, Mg, Mn, Cr, Zn, Mo, P, K, Na and Ca.

## Introduction

The organic world is sustained by plants through the fundamental process of photosynthesis. The way in which plants influence life on earth is remarkable. Plants have provided all the basic needs of man ever since his birth and evolution. Plants are the source of food, medicine, fuel, fiber etc. As civilizations developed people identified and used many other plants that yielded spices, oil, and selected forage and fodder grasses for the animals that they domesticated.

Plants synthesize primary metabolites (proteins, fats, nucleic acids and carbohydrates) by simple substances such as water, carbon dioxide, nitrogen and a number of inorganic salts in small amounts. These primary metabolites are transformed into secondary metabolites (alkaloids, steroids, terpenoids, saponins, flavonioids etc) that are used as drugs.

The World Health Organization (WHO) recognized traditional medicine or herbal medicine about 20 years ago and started exploring the possibilities to improve or popularize the herbal medicine already used by the people in developing countries of the world for thousands of years (Akerle *et al.*, 1991).

Herbs not only provide us chemicals of medicinal value but also provide us nutrition and trace elements. Minerals and trace elements are chemical elements required by our bodies for numerous biological and physiological processes that are necessary for the maintenance of health. Those that are required in our diets in amounts greater than 100 milligrams per day are called "minerals" and those that are required in amounts less than 100 milligrams per day are "trace elements." Minerals include compounds of the elements calcium, magnesium, phosphorus, sodium, potassium sulfur and chlorine. Trace elements that are necessary for human health include iron, iodine, copper, manganese, zinc, molybdenum, selenium, and chromium etc., (Hendler, 1990). In the present study the nutritional value and trace elements content in *Carthamus oxyacantha*, *Eruca sativa* and *Plantago ovata* plants are investigated.

## Materials and Methods

*Carthamus oxyacantha*, *Eruca sativa* and *Plantago ovata* plants (leaves and seeds) were collected from the fields and identified at taxonomy section Department of Plant sciences, Faculty of Biological Sciences, Quaid-i-Azam University, Islamabad, Pakistan. Seeds and leaves were then washed, dried and powdered mechanically with a china herb grinder. The powder was kept in dry, clean, air tight glass jars and stored at $4^oC$ until used.

Estimation of crude proteins was done by Kjeldahl method (Kjeldahl, 1883). Total proteins were estimated by Lowry s' Method (Lowry *et al*., 1951). Crude fat was estimated by Rose-Gottlieb method (Triebold & Aurand, 1982). Crude fiber was estimated (Triebold & Aurand, 1982) by mixing the residue left after the extraction of crude fat with 0.5g asbestos and 200 ml of boiling sulfuric acid for digestion; the contents were filtered and residue was mixed with sodium hydroxide and again digested for 30 minutes in a reflux condenser; residue was dried, weighed and ignited; the difference in initial and final weights was taken as the weight of crude fiber. Sugars were estimated by the method of Dubois *et al*., (1956). Estimation of total minerals was done by straight ash combustion method (Triebold & Aurand, 1982). For trace elements and heavy metals the plant material was digested with a mixture of perchloric acid and nitric acid in fume hood (Halvin & Soltanpour, 1980). Estimation was done by using Fast Sequential Atomic Absorption Spectrophotometer (AA240.FS). Data was analyzed using computer program SPSS.

## Results

***Carthamus oxyacantha*****:** Table 1 shows the chemical composition of *C. oxyacantha* leaves and seeds. Leaves of *C. oxyacantha* contain crude proteins (21.87±2.8%) and total carbohydrates (18.9±4.2%) as the major components, while K (1920±70ug/g), Ca (1400±50ug/g), P (799 ± 17.9ug/g), Mg (726±12.6ug/g) and Na (340±60ug/g) were estimated as the major trace elements. Seeds of *C. oxyacantha* contain crude fats (35.6±5.9%) and crude fiber (35.5±7.2%) as the major components along with Ca (2600±20ug/g), K (2200±80ug/g), Mg (683±13.8ug/g), and P (577±15.3ug/g).

***Eruca sativa*****:** Table 2 shows the chemical composition of *E. sativa* leaves and seeds. Leaves of *E. sativa* contains crude proteins (16.6±3.2%), total carbohydrates (16.9±1.1%), Mg (709±15.7ug/g), Ca (700±30ug/g) and Na (440±50ug/g). Seeds contain crude proteins (26.26±1.9%) and crude fats (25.6±2.6%), P (3183±16.8ug/g), Ca (1900±40ug/g), Na (1100±20ug/g), K (720±20ug/g) and Mg (695±14.1ug/g).

***Plantago ovata*****:** Table 3 shows the chemical composition of *P. ovata* leaves and seeds. Leaves of *P. ovata* contains crude proteins (21.87 ±4.7%), total carbohydrates (15.9 ±1.3%), Ca (500±30ug/g), K (517±20ug/g), Mg (957±17.3ug/g) and Na (412±40ug/g). While seeds contain, crude fats (43.2±6.3%), crude fiber (48.5±9.8%), Ca (1600±80ug/g), Na (1200±60ug/g), K (1000±60ug/g) and P (627±12.3ug/g).

**Table 1. Chemical composition of *Carthamus oxyacantha*.**

| Observation | Seeds | Leaves |
|---|---|---|
| **Chemical composition ( % )** | | |
| Crude proteins | 13.5 ± 1.3 | 21.87 ± 2.8 |
| Total protein | 10.7 ± 1.6 | 15.3 ± 1.4 |
| Crude fats | 35.6 ± 5.9 | ------ |
| Crude fiber | 35.5 ± 7.2 | 6.0 ± 1.2 |
| Total Carbohydrates | 15.4 ± 4.6 | 18.9 ± 4.2 |
| Total minerals(ash) | 9.5 ± 1.8 | 9.3 ± 2.1 |
| **Trace elements (ug/g plant material)** | | |
| Ca | 2600 ± 20 | 1400 ± 50 |
| Cd | 0.003 ± 0.0004 | ------ |
| Cr | 0.629 ± 0.006 | 0.839 ± 0.03 |
| Cu | 27.4 ± 8.7 | 21.7 ± 6.2 |
| Fe | 49.8 ± 7.9 | 19.0 ± 4.7 |
| K | 2200 ± 80 | 1920 ± 70 |
| Mg | 683 ± 13.8 | 726 ± 12.6 |
| Mn | 22 ± 5.6 | 38 ± 4.7 |
| Mo | 0.25 ± 0.0031 | --------- |
| Na | 1000 ± 10 | 340 ± 60 |
| Ni | ---------- | 0.092 ± 0.001 |
| P | 577 ± 15.3 | 799 ± 17.9 |
| Zn | 39.8 ± 1.8 | 30.7 ± 4.6 |

**Table 2. Chemical composition of *Eruca sativa*.**

| Observation | Seeds | Leaves |
|---|---|---|
| **Chemical composition (%)** | | |
| Crude proteins | 26.26 ± 1.9 | 16.6 ± 3.2 |
| Total protein | 18.2 ± 2.7 | 12.1 ± 1.4 |
| Crude fats | 25.6 ± 2.6 | 6.6 ± 1.3 |
| Crude fiber | 2.5 ± 0.7 | 14 ± 3.8 |
| Total Carbohydrates | 15.6 ± 1.8 | 16.9 ± 1.1 |
| Total minerals(ash) | 8.5 ± 2.5 | 9.5 ± 2.3 |
| **Trace elements (ug/g plant material)** | | |
| Ca | 1900 ± 40 | 700 ± 30 |
| Cd | 0.0135 ± 0.0006 | 0.00532 ± 0.0002 |
| Cr | 10.663 ± 1.08 | 4.72 ± 0.03 |
| Cu | 32 ± 5.2 | 21 ± 5.6 |
| Fe | 60.62 ± 9.5 | 37.5 ± 5.6 |
| K | 720 ± 20 | 313 ± 40 |
| Mg | 695 ± 14.1 | 709 ± 15.7 |
| Mn | 19 ± 3.6 | 10.6 ± 2.8 |
| Mo | 0.19 ± 0.0005 | --------- |
| Na | 1100 ± 20 | 440 ± 50 |
| Ni | 0.0423 ± 0.001 | 0.139 ± 0.006 |
| P | 3183 ± 16.8 | 348 ± 17.5 |
| Zn | 56.1 ± 6.7 | 1.12 ± 0.09 |

**Table 3. Chemical composition of *Plantago ovata.***

| Observation | Seeds | Leaves |
|---|---|---|
| **Chemical composition (%)** | | |
| Crude proteins | 13.12 ± 2.1 | 21.87 ± 4.7 |
| Total protein | 11.8 ± 0.9 | 9.3 ± 1.5 |
| Crude fats | 43.2 ± 6.3 | --------- |
| Crude fiber | 48.5 ± 9.8 | 6.8 ± 1.4 |
| Total Carbohydrates | 8.4 ± 2.5 | 15.9 ± 1.3 |
| Total minerals(ash) | 8.6 ± 1.9 | 9.3 ± 2.3 |
| **Trace elements (ug/g plant material)** | | |
| Ca | 1600 ± 80 | 500 ± 30 |
| Cd | ----- | ----- |
| Cr | 11.754 ± 0.01 | 0.68 ± 0.03 |
| Cu | 59 ± 7.3 | 45 ± 9.6 |
| Fe | 21.7 ± 4.8 | 67.5 ± 8.9 |
| K | 1000 ± 60 | 517 ± 20 |
| Mg | 63.5 ± 10.5 | 957 ± 17.3 |
| Mn | 6.0 ± 1.2 | 3.1 ± 0.7 |
| Mo | --------- | --------- |
| Na | 1200 ± 60 | 412 ± 40 |
| Ni | 0.0213 ± 0.0001 | 0.18 ± 0.03 |
| P | 627 ± 12.3 | 267 ± 13.7 |
| Zn | 99.4 ± 10.8 | 88 ± 11.5 |

## Discussion

Health treatments based on medicinal plants are being prescribed by doctors in the form of plant extracts, infusion or by direct ingestion of very fine powder of plant. Likewise these are recommended as a nutritional supplement for the treatment of everyday problems such as stress and insomnia. There is a resurgence of interest in herbal medicine for the treatment of various ailments, chiefly because of the prohibitive cost of allopathic drugs, their unavailability in remote areas and the popular belief that naturally occurring products are without any adverse side-effects (Hungard *et al.,* 1988). Similarly Ahmad (2007) highlighted the importance of wild medicinal plants along road side varges (M-2) Pakistan.

From a medical point of view, the important constituents of plants are pharmacologically active compounds such as flavonoids, alkaloids, glycosides and similar other organic substances. In addition, medicinal plants contain essential and trace elements, which can be available to the human body on consumption of herbs and their extracts. Indeed today many, if not most, pharmacological classes of drugs include a natural product prototype. The search for pharmacologically active chemicals from plant sources has continued and many compounds have been isolated and introduced into clinical medicine. Modern medicine is now beginning to accept the use of standardized plant extracts. Present study was also conducted to enhance the same knowledge further and is focused to investigate chemical composition including estimation of nutritional value, trace elements / heavy metals of *C. oxyacantha, E. sativa* and *P. ovata*.

The seeds of *C. oxyacantha* are a better source of crude fats (35.6±5.9), crude fiber (35.5±7.2), Ca (2600 ±20), K (2200 ±80), Na (1000 ±10), Fe (49.8 ±7.9), and Cu (27.4 ±8.7) as compared to the leaves. While leaves are found to be a better source of crude proteins (21.87±2.8), total carbohydrates (18.9±4.2), P (799±17.9) and Mg (726±12.6) as compared to the seeds. The values for crude fat and crude fiber in seeds and crude proteins and total carbohydrates in leaves are better than the *Taraxacum officinale,* a herb belonging to family Asteraceae (Rubatzky & Yamaguchi 1997). This difference may be due to the difference in the anatomical structures and the physiology of two plants.

The values for Ca, Mg, Zn, Fe, K, and Na are significantly higher as compared to the *E. purpurea* a medicinal plant of the *asteraceae* (Razic *et al.,* 2003). The concentration of Mn is less as compared to the *E. purpurea.* The concentration of Ca, P, Na, Fe, Mg, Zn and Cu are better than the *Taraxacum officinale* while the concentration of K and Na are less as compared to the *Taraxacum officinale* (Rubatzky & Yamaguchi 1997). Although these three plants, *E. purpurea, T. officinale* and *C. oxyacantha* belong to the same family but are of different genera and species. This may explain the difference in the trace element content.

The seeds of *E. sativa,* contain more crude proteins (26.26±1.9), total fats (25.6±2.6), total proteins (18.2±2.7), P (3183±16.8), Ca (1900±40), Na (110020), K (720±20), Cu (32±5.2) and Mn (19±3.6) as compared to the leaves. The amount of total carbohydrates (16.9±1.1), crude fiber (14±3.8), total minerals (9.5±2.3), Mg (709 ±15.7) and Fe (37.5±5.6) as compared to the seeds is higher in leaves as compared to the seeds. The values for total fats and total proteins are better than *Brassica oleracea gongylodes* L,. (Duke & Ayensu 1985). The values for total carbohydrates crude fiber and total ash are less as compared to the *Brassica oleracea gongylodes* L. Heavy metals are found to be in negligible amounts in both seeds and leaves. The values for Ca, P, Fe and K in both seeds and leaves of *E. sativa* are significantly less as compared to the *Brassica rapa* L., and *Brassica oleracea gongylodes* L., (Duke & Ayensu 1985). Again the difference in different parameters may be due to the difference in anatomical structures of the plants as well as their habitat.

Seeds of *P. ovata* contain significantly higher amount of crude fiber (48.5±9.8) total fats (43.2±6.3), total proteins, total minerals, Ca (1600±80), Na (1200±60), K (1000±60), P (627±12.3), Zn (99.4±10.8), Mg (63.5±10.5), Cu (59±7.3) and Fe (21.7±4.8) as compared to the leaves. The concentration of the crude proteins (21.87±4.7), total carbohydrates (15.9±1.3) in leaves are significantly higher as compared to seeds. The amount of total / crude proteins is significantly higher as compared to the *P. minor* (Ertan *et al.,* 2001). The amount of Ca, K, Na and Fe is less as compared to the *P. minor*. The amount for P, Mg, Zn, Mn and Cu is higher as compared to the *P. minor* (McCollum, 1992). The amount of Na, Cu and Zn in both leaves and seeds is significantly higher as compared to the *P. lanceolata* L., (Queralt *et al*., 2005). The amount of rest of all the studied elements is significantly less as compared to the *P. lanceolata* L.

Crude proteins, total proteins in seeds and total carbohydrates in leaves are significantly higher in *E. sativa as* compared to the *C. oxyacantha* and *P. ovata.* The amount of total fats is significantly higher in seeds of *C. oxaycantha* as compared to the *E. sativa and P. ovata*. The concentration of crude fiber is significantly higher in seeds of *P. ovata* as compared to the seeds and leaves of both *E. sativa* and *C. oxayacantha.*

Trace elements are essential for normal growth of plants, their protection against viruses and completion of their life cycle (Bennet *et al.,* 2000). The differences in concentration of various elements may be due to the differences in botanical structures of the plants and also due to the mineral composition of the soil. Moreover the difference may be due the ability of plants to accumulate the elements from the surrounding aerial or aquatic environment either for heir physiological requirement or as a precautionary measure. This in turn enables some plants to be used as biomonitors for environmental pollution (Viksna & Selin, 2001).

In all the three plants studied the concentration of Mg and Ni is higher in leaves as compared to the seeds. This may be due to the fact that Mg is not only essential trace element but it is also a constitutive part of the chlorophyll. The Ni is essential for growth as well as mobile in the plant body (Bennet *et al*., 2000). This probably explains its higher concentration in leaves as compared to the seeds. Cd is found to be either absent or in negligible amount in all the three plants.

The content of Cu, Mg and Ca also depends on both season and the plant tissue. Zn is found to be in significant amounts in both seeds and leaves of *C. oxycantha* and *P. ovata* as compared to the *E. sativa.* Zn along with Fe and Mn are reported to be important immunostimulant (Razic *et al*., 2003).

The biological effects of the trace elements in living system strongly depend upon their concentration and thus should be carefully controlled especially when herbs and drugs are used in human (Jacob, 1994). Cr is implicated in maintenance of blood sugar, prevention of arteriosclerosis and control of cholesterol levels. Human studies suggest that chromium picolinate enhances insulin sensitivity, glucose removal and may improve lipid ratios in obese and type 2 diabetics (Cefalu *et al*., 2002). It is also suggested that Cr has a potential beneficial antioxidant effect in patients with type 2 diabetes when combined with Zn and Cu supplementation (Anderson *et al*., 2001).

Mn is a component of several enzymes including manganese-specific glycosyltransferase and phosphoenolpyruvate carboxykinase and essential for normal bone structure. Mn deficiency can manifest as transient dermatitis, hypocholesterolemia and increased ALP level.

Mo is a component of coenzyme that is essential for the activity of xanthine oxidase, sulfite oxidase and aldehyde oxidase (Nielsen, 1995). It acts as a detoxification agent in the liver as a part of the sulfite oxidase enzyme and it possibly retards degenerative diseases, cancer and aging.

Cu is universally important cofactor for many hundreds of enzymes. It functions as a cofactor and activator of numerous enzymes which are involved in development and maintenance of the cardiovascular system. A Cu deficiency can result in a decrease in the tinsel strength of arterial walls, leading to aneurysm formation and skeletal maldevelopment (Tilson, 1982).

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